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USSR Report

ENERGY

(FOUO 20/81)

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CONTENTS

FUELS

INFRASTRUCTURE DEVELOPMENT OF WEST SIBERIAN OIL AND GAS COMPLEX DESCRIBED

Moscow VOPROSY EKONOMIKI in Russian No 8, Aug 81 (signed to press 11 Aug 81) pp 35-45

[Article by Aleksey Davidovich Khaytun, candidate of economic sciences, head of laboratory of the Institute of Economics and Management of the USSR Ministry of Construction of Oil and Gas Industry Enterprises: "West Siberian Oil and Gas Complex: Socioeconomic Aspect"]

[Text] Development of the West Siberian oil and gas complex is the largest territorial-production program for developing natural resources for the next decades.

The north is viewed as a zone of production and economic development of natural resources. It is distinguished by remote geographical location from inhabited economic regions and industrial centers, by harsh natural conditions which prevent the development of agriculture and impair the development of many industrial sectors, by increased outlays of human and reified labor for work done here, by natural, climate and socioeconomic conditions that are unfavorable for permanent settlement, and by low population density.

The basis for development of production in the developed northern regions is the extracting industry. Its specific weight for Siberia is 2.3-fold higher than on the average for the country. The refining industry develops at the later stages of development, although it is often economically more advantageous to create a whole complex for extraction and refining. The population of the north is mainly concentrated in the foci of development. The distance from the main production and economic centers, the vastness of the territory, and the lack of development of the road network limit the transport accessibility. Transportation expenditures comprise a considerable part of the price structure. Transporting construction freight to the Ob' area in the Tyumenskaya Oblast, for example, reaches 57% of the cost of the construction and installation work in building up the oil fields. The expenditures rise significantly in the extreme north, therefore, valuable raw material, gold complex ores, etc. are mainly exported. The largest freight of the north, timber, is chiefly shipped by water. Selection of the timber areas is associated with the presence of natural communications passages. Transporting oil and gas is an exception, however. It requires construction of a powerful and expensive system of main pipelines.

During focal development, the industries gradually join up with a complex of service sectors. A local, social and production infrastructure is created which is relatively less efficient since it is characterized by small-sized enterprises

designed for considerable contingents for maintaining and repairing the equipment of the main industries; by limited local raw material base because of a lack of farming and animal husbandry; by labor intensity and high cost of the products because of the small scales of production, increased wages and high transportation costs.

Water transportation and long-distance truck hauling are the most developed. Water shipping under northern conditions is limited, however, by the periods of navigation, difficulties in reloading cargo from sea to river transportation, the insufficient number of ports, piers and the poor development of the warehouse system. Truck hauling is done during the winter on frozen rivers and swamps ("winter roads"). This doubles the cost as compared to shipping on automobile roads. The specific capital outlays for building railroads and roads doubles and triples as compared to the European sector of the USSR. Construction of airports is complicated and expensive. In this case it should be taken into consideration that air transportation operates with interruptions because of the northern weather conditions.

Thus, the main characteristics of the northern economy are: orientation on extraction of highly efficient minerals, focal nature of the development of the assimilated regions; need to guarantee autonomy of the foci of development in local infrastructure. All of these factors are fully inherent to development of the northern oil and gas regions, which, however, have additional specific features.

Focal development of natural resources occurs simultaneously in different places of the vast region. Whereas a focal nature is inherent to development of an individual field or group of fields, interrelationship of elements, interdependence of the periods for development of each local center of development and the entire region are inherent to the development process as a whole. The infrastructures that accompany the main branch industry, although they have a closed nature and are created to primarily service the local needs, are united together by many bonds into the infrastructure of the region of development. The same is true for the social infrastructure. It has common elements and is included in a unified developing system of settlement.

The oil and gas complex is distinguished from other regions of northern development by the volumes of transporting of the finished product. Up to 300 million tons of oil were transferred from West Siberia on gas pipelines in 1980. The average distance of shipping exceeded 1000 km and the gas pipeline productivity rose by more than 350 trillion cubic meters per kilometer.

Build-up of the oil fields requires shipping by general-use carrier of no less than 20 million T of freight each year. Construction of only one branch of the main large diameter gas pipeline from the northern regions of the Tyumenskaya Oblast requires hauling about 5 million T of freight. The transportation system which unites the specialized pipeline transport of finished product and general-purpose transport (railroad, roads, waterways, aviation) thus integrates the foci of development into a unified national economic complex. This is guaranteed not only by the direct organizational function of transportation, but also by the fact that during the construction and operation of the powerful transportation systems, an infrastructure is created in the "corridors" of supply lines which supplements the focal structure as the binding link of the complex.

The shortage and national economic importance of natural resources of the oil and gas complex also determine such a feature as its rates of development. There is essentially no time interval between the discovery of the fields and the beginning of build-up of the industry that is sufficient for the successive evolution of a supply system base for the main industries.

The general plans of the cities and settlements are in effect for over 20-25 years. Selection of the location of the population area, exploratory work and city designing and building are also associated with lengthy periods. At the initial stage of exploration of the oil field, it is difficult to define its expected output, to plan for tie-in of the production base, and to establish the need for labor resources, that is, the initial information needed for city designing and building. As shown by experience, if a newly discovered oil field has industrial importance, it will be involved in intensive production development in the shortest periods. Its characteristics (reserves, productivity, methods of extraction and transportation, etc.) are pinpointed during the process of construction and operation. City designing and building therefore inevitably includes temporary solutions of its initial stage as an important element.

The period of effective operation of the oil field, depending on its output, is counted in 10-15 years, after which extraction diminishes. However, this does not signify a proportional reduction in the need for labor resources. In order to maintain a stable level of extraction at the fields which are becoming depleted it is necessary to drill additional oil wells, have forced maintenance of the formation pressure by flooding and injecting gas, etc. On the contrary, automation of oil extraction reduces the need for workers to run the fields, and at the same time construction work to build-up the field is cut back. In individual, local zones of development, the period for optimal functioning of the base production around which they are formed is consequently reduced, and even more so, the period for increased demand for labor resources. Finally, the natural features of the West Siberian oil and gas complex includes an extremely limited number of areas that are suitable for the formation of permanent settlements. The northern area of West Siberia is characterized by vast peat bogs and widespread permafrost. The oil and natural gas fields in many cases are located under such conditions that it is not expedient to build a city or workers' settlement in direct proximity to them. In some cases the created population area is not able to expand since this is associated with expensive work for engineering preparation of the territory (building up the ground, special measures to preserve the permafrost, etc.).

The majority of developed fields are located on swamps, lakes and flooded sections[1] (in % of the total field area):

Field	Swamps	Lakes	Floodplain
Samotlor	60	15	4
Ust'-Balyk	50	12	67
Mamontovskiy	40	6	9
Var'yeganskiy	37	35	-
Pravindsk	40	3	10

Thus, the process of developing the northern Tyumenskaya Oblast is characterized by a monoresource type of development which is based on extraction of hydrocarbons (oil, casing head and natural gas), by large scales and rates of development, by

the creation of powerful pipeline systems and transportation trunklines of general use, and the related unification of foci of development into a territorial complex, by short periods of operation of individual fields and by indefiniteness of the outlook for development of the associated population area and the infrastructure in the foci of development beyond these periods.

Production development is viewed as the first stage of the subsequent settlement of the territories. It is often implied that settlement is precisely the basic socioeconomic goal of forming production forces of new industrial complexes. At the same time practice does not confirm the universality of this thesis. In particular, after working forest tracts, the lumber industry settlements are closed in many cases. The permanent population is significantly reduced. On the contrary, all the previously discovered large oil fields have become the center of development for a system of permanent settlements, while the largest ore fields (Magnitogorsk, Noril'sk) have become the base for the creation of modern well-built and fairly large cities.

It is expedient in this respect to examine the correlation between the concepts of development of a territory and its comprehensive development and settlement. Territories and regions that were not previously settled and are characterized by an undeveloped infrastructure and the lack of a production base are subject to development. Settlement of the territory, in turn, depends on the historical conditions and level of development of the country's production forces. Permanent settlements have currently been set up in near-polar regions of the European North that were previously considered unfavorable for the development of large cities (for example, Murmansk and its associated system of cities and settlements). Individual regions in East Siberia, in particular, the zone of the Angaro-Yenisey power engineering complex, are characterized by roughly the same process of transition from the stage of development to permanent settlement.

In our opinion, a condition for settlement is the availability of a permanent production base which guarantees specialized employment for the population for a long time, as well as the level of development of the infrastructure, primarily, municipal engineering structures, road network and housing fund, and auxiliary production sectors.

A distinguishing feature of the settlement stage is expanded reproduction of the local population. Migratory processes of Siberia are characterized in individual periods by a negative balance, that is, an efflux of labor resources to the European sector of the country. Total growth in population is guaranteed by a natural increase. The labor resources are supplemented to a considerable measure because of the native population, the Siberians of the second and third generations. In this case the socioeconomic and natural-climate conditions which guarantee expanded reproduction of the population are the definitive prerequisite that creates the possibility of a transition from the stage of development to permanent settlement.

When these conditions are present, development can be viewed as the initial stage of subsequent settlement of territories which are suitable for permanent residence. The West Siberian oil and gas complex does have these regions. Permanent settlement of them after exhaustion of the main natural resource is inexpedient at the given stage of development of the productive forces.

The development of the West Siberian oil and gas complex is characterized by contradictions between the resource nature of the production development and the need to comprehensively develop the social infrastructure which are objectively inherent to the socioeconomic development of the north; by the limited periods for effective development of the foci of development on the basis of oil and gas, and by the long-term nature of settlement; by the need to set up a complex of socioeconomic conditions in a short period and by the rapid rates of production development; by the focal nature of development and by the need for balanced development of the complex as a unified whole.

It has been suggested that the expedition-watch method of developing new territories be used to resolve these contraditions.[2] The use of this method, as well as the correlation of interregional and intraregional use of labor resources depend to a considerable measure on the specific socioeconomic and natural conditions of the different regions.

The West Siberian oil and gas complex encompasses the regions of the Tyumenskaya Oblast and part of the northern regions of the Tomskaya Oblast. This territory is customarily divided into seven regional territorial production complexes: Tyumen'-Tobol'sk, Central Ob' area, Sos'vinskiy Ob' area, Kondinskiy Ob' area, Nizhneobsko-Yamal'skiy, Nadym-Tazovskiy and Vasyugan-Tymskiy which are at different stages of formation.[3]

The majority of TPC [territorial production complexes] are associated with the gas and oil industry. Of the new branches of economy, one can only isolate the industry of construction materials and power engineering (Central Ob' TPC) in the structure of the northern TPC at this time. Reindeer breeding is traditional in these regions (in Central Ob' area , meat and dairy animal husbandry with foci of farming), as well as forestry and fishing.

The development methods used in these TPC have a similarity. Depending on a number of natural-climate and economic factors, including the level of development of the transportation systems, however, one can also reveal definite differences. For an understanding of the specific nature of development of the oil and gas complex in West Siberia and the creation of a system of settlement associated with the complex, the suggested zoning of the region is excessively fragmented and impairs a detection of the main laws.

It has been suggested[4] that four main zones be isolated in the oil and gas regions of West Siberia. They are distinguished in the set of economic and natural factors. and correspondingly, the methods of production and social development. These factors include: 1) climate, relief and soils, hydrographic characteristics; 2) minerals (primarily oil, gas, gas condensate); 3) transportation system and infrastructure, level of development (industrial development, settlement, social infrastructure); 4) medical and biological assessment of the suitability of the territory for permanent residence.

The suitability for permanent residence depends on the sanitary-hygienic conditions which have a stochastic nature. Nevertheless, assessment of them which is based on an analysis of morbidity and physiological studies, is possible and desirable if only to determine the original level of economic stimulation of migrants. The remaining factors depend on the degree of study of the natural resources and the

stage of development of the territory. The natural-climate conditions can be taken into consideration in the medium-range prediction of socioeconomic development of the region as unchanged (anthropogenic effect on the environment is ignored in this case).

The set of natural, economic and social conditions which influence the course of production assimilation and development of the system of settlement even now determines the zonal differences in the assimilated oil and gas regions of the Tyumenskaya Oblast.

The first zone is the territory of the Yamalo-Nenetskiy autonomous okrug. The main natural resources are fields of natural gas, condensate and oil. The country's largest Urengoy field is partially located on the southern boundary of the zone. Formation of the country's most important base for natural gas extraction will begin in the 11th Five-Year Plan in this zone.

Freight is mainly transported over the northern sea route (with unloading onto the ice), on rivers and "winter roads." It is also possible to ship freight on the railroad through Vorkuta, and further on winter automobile roads. Construction of a system of gas pipelines from the northern fields and build-up of the largest natural gas fields are planned. The population in this zone is small and is mainly concentrated on the southern borders, river banks, as well as near the developing fields. The zone is considered practically unsuitable for permanent residence and acclimatization of the ecdemic population according to the set of climate conditions and the development of municipal settlements. The population change, according to medical studies, is required every 1-3 years.

The second zone is the southern part of the Yamalo-Nenetskiy okrug and the Siberian Urals. This is a zone where the largest natural gas fields and industrial fields of gas condensate and oil have been explored in the intefluvial area of Nadym, Taz and Messoyakha. The county's main base for gas extraction was started here in the 10th Five-Year Plan. Over 150 billion m^3 were extracted in the Ob' area in 1980. The gas reserves already exceed 10 trillion m^3. The cities of Nadym and Urengoy, as well as the administrative capital of the okrug, Salekhard, have begun to develop in the regional gas fields. Change of the ecdemic population in this zone is expedient every 3-7 years.

The third zone is Central Ob' area. Oil fields have been explored here and a new base has been formed for oil extraction in the country. Khanty-Mansiyskiy autonomous okrug, and the northern regions of the Tomskaya Oblast belong to this zone according to administrative division.

Oil fields have been explored in Ob' area including the Samotlor field, Fedorovskiy, Mamontovskiy, Yuganskiy and others. The urban population, according to a census, rose in 10 years by more than 400,000. Large cities of Nizhnevartovsk, Surgut and Nefteyugansk have been formed.

This zone is at the stage of intensive development and assimilation. According to the natural-climate conditions, the territory is suitable for permanent settlement, however, as a result of the insufficient development of the infrastructure, including a base for the construction industry and supply lines, city designing and building is difficult.

The fourth zone is the southern regions of the Tyumenskaya Oblast that are adjacent to the oil and gas zones. These are regions with developed agriculture, formed cities (Tyumen', Tobol'sk and others), and a climate favorable for the population. Routes of oil pipelines and trunkline gas pipelines (Urengoy-Chelyabinsk) pass through the southern Tyumenskaya Oblast. Here there is a production base of the sectors of the oil and gas complex, planning and scientific organizations, and administrative-managerial apparatus of the central boards and associations. All of this allows us to view the southern zone as the base for development and to rank it territorially in the West Siberian oil and gas complex.

Zoning of the territory is necessary in order to pinpoint the plans for development of the region and to plan the most efficient methods for developing the region and each zone. These methods are significantly governed for the future by the already noted development trends since they are based on the previously created production base and the formed infrastructure. The process of further development is therefore predetermined a great deal by the decisions that were made in the beginning of the period. There have been changes in the rates of development of industry over the zones of the oil and gas complex, in the correlation of the specific weight of these zones in capital investments and production of the final product, and in the population and dynamics of population increase. The approach to the methods of development which depends on the features of each system has correspondingly changed.

The watch method is characterized by concentration of the population in the base cities and creation of watch settlements directly in the facilities of labor activity, the organization of stable supply lines of transportation and communications between the base cities and the watch settlements.[5] The focal nature of development of the north in the watch method acquires the features of a group system whose production structure unites around the organizational-economic center of the zone of labor activity. The social infrastructure is correspondingly divided into zones of the concentrated base settlement and the zones of mobile settlement. The group system under the watch method is mainly closed within the region of development, obtaining material resources from the outside, and realizing the final product beyond the limits of the region. The labor resources in this case are used within the group system, while the social infrastructure of the base settlement must be designed for all the workers of the development region and their families. The infrastructure of the mobile zone primarily encompasses those working by the watch method.

The interregional or interrayon use of labor resources in limits of a large region distinguishes the expedition-watch system of development from the watch method. As applied to West Siberia, the labor collectives, and in certain limits, the production plants are distributed between the zones or group systems of development. The social infrastructure in the expedition-watch system of developing new regions is divided into zones of mobile, base and supporting settlement.

The zones of mobile settlement include the watch settlements and field cities of builders which are grouped around the base cities and the workers' settlements. The facilities of production activity are correspondingly grouped around the organizational-economic centers. The supporting zone and the centers of settlement can be located both beyond the limits of the zone, and beyond the limits of the region, in inhabited regions of the country. This system of development can have

a simpler structure: the direct transportation links between the supporting and the mobile zones. This is characteristic for construction of main pipelines and geological exploration. The mobile zone in this case is formed by the field cities and expedition settlements which have great autonomy and short periods of existence. The links between the supporting and mobile zones are correspondingly organized for relatively short periods, are designed for lower intensity of use, and are therefore less stable.

The zone of the base settlement and the organizational-economic centers fulfill additional functions of linkage with the supporting city. They act as central points on the movement route of the labor resources. The base cities simultaneously acquire importance of supporting centers for further advance to the north and development of new fields by the expedition method. Interaction of the group systems of development is implemented through these cities.

The traditional method of development is oriented on stable centralized settlement near the facilities of labor activity on the territory where the development of permanent settlements is most likely in the future. The network of these settlements forms the population points of varying specialization. In the traditional method, the zones of labor activity and residence are isolated to a slight degree. They are separated in the boundaries of the forming populated area: city and workers' settlement. The focal nature of development of the north is manifest especially clearly.

The correlation of methods of development also depends on the stage of development of the zone. From the beginning of formation of the West Siberian oil and gas complex, the main capital investments have been directed to the oil industry and the accompanying infrastructure of Central Ob' area. New cities and settlements have been intensively built here.

The near-polar zone of the Tyumenskaya Oblast began to develop later. It initially lagged both in rates and in scope of development. The near-polar zone began to develop at advance rates in the 10th Five-Year Plan, in addition to the intensive development of Central Ob' area. The country's largest base for natural gas extraction is being created here, oil fields are being developed, and cities and settlements are being built.

The following stages are characteristic[6] for the development of the systems of settlement of the assimilated regions: preparatory stage when regions of primary assimilation are defined and a model is formed for the development and placement of the productive forces; beginning of expansion of the production and social infrastructure, appearance of centers of regional importance, development of regional ties, and correspondingly, a system of regional planning; intensive industrial and social development, the appearance of all links in the taxonomical system of settlement[7], the supporting and base centers of group and centralized systems; establishment of stable intrasystem bonds, designation and isolation of boundaries in the system of settlement, stabilization of the system and slowing down of the growth rates; further development of the settlement system.

The transpolar zone is in the first stage of development. The near-polar zone is in the second, and Central Ob' area is in the third. The southern regions of the Tyumenskaya Oblast do not completely fit into this classification since according to the level of development of the infrastructure and length of settlement they belong to the comparatively inhabited regions.

Interregional use of labor resources is employed most widely at the initial stages of development. In this case the first stage is characterized by the combination of expedition and expedition-watch methods, while the second, by the expedition-watch, watch and traditional methods. The specific weight of the interregional use of resources is further reduced.

The development methods are influenced by the traditions for organization of production in different sectors. In the oil and gas complex, the geological explorers and line builders of the main pipelines are the most mobile. Intra-regional distribution of resources is inherent to the oil industry, however the rapid rates of development of the northern fields required the use of the expedition-watch method as well. In the gas industry, which is relatively less labor-intensive, the development of new forms of labor organization and the watch method occur slowly. Finally, industrial and housing construction, transportation and power engineering still do not use the new methods of development.

The following concept is thus formed for the development of the regions of the West Siberian oil and gas complex: simultaneous use of traditional, watch and expedition-watch methods, expansion of the scales of use of the expedition-watch method as an advance to the north is made; use of the southern zones of West Siberia and other inhabited regions of the country beyond the limits of this region as the base for development of the northern regions; formation of cities of the Ob' region as base cities of the zone, and simultaneously supporting for the more northern zones; demarcation of development of cities in the near-polar region, use in the structure of these cities of mobile elements; use of the cities of the southern area of West Siberia as supporting for the norther zones and the Ob' region; development of the transpolar zone primarily by the expedition-watch method with base in the cities of the Ob' region, south Siberia and beyond the limits of the region. It is desirable that this zone avoid building cities and major workers' settlements.

The chief shortcoming of traditional city designing and building development of West Siberia is low efficiency of the housing-civil construction because of decentralization of the construction industry base for a large number of simultaneously developing settlements and small cities. The watch method guarantees high concentration of housing-civil construction and drastically reduces the transportation expenditures of the construction organizations. The social-general services are also improving for the population of the created cities. This method does not eliminate many contradictions in the rapid socioeconomic development of the regions of new development, since it is necessary to completely provide all the population of the developing regions with a housing fund in the cities, and at the same time, a housing fund in the watch settlements. This is economically quite expedient since it is covered by the saving of capital investments through concentration of the construction sites, however, it results in diversion of the facilities of the construction organizations to the watch settlements, and at the same time, slows down the development of the base cities.

The expedition-watch method and interregional use of the labor resources make it possible to conduct a labor-conserving policy to a greater measure, and to limit the growth of the northern cities with simultaneous concentration of the housing construction. At the same time, the social aspects of this method are associated with a significant change in the lifestyle. A higher level of production organization is also required.

On the whole, despite the limiting effect of the new methods of development and the high percentage of those involved in the leading sectors (up to 64% of the population in 1980), the region's population is rising rapidly, in subsequent years it will lead the rates of increase in oil and gas extraction. This is explained, besides the production factors, by the process of urbanization, development of the service sphere, that is, development of roots of the region. As a consequence, the specific indicators of production of the final product, oil and gas, reduced to comparison fuel, were stabilized at the end of the 1970's, and their further decline is predicted:

Specific annual production (in T of comparison fuel)	1970	1975	1980	1985 plan	1990 prediction
Per one employed	431	1438	1711	1244	1080
Per one person in the population	280	1060	1090	700	580

The data in the table show that the growth trends (and the predicted indicators) depend on the program of extraction and the plan for use of the labor resources.

Because of the rapid growth in the population of the oil and gas complex, the problem of accelerated housing-civil construction is advanced as the most important. The provision with enterprises of the general services for the oil and gas regions of West Siberia was 86% in 1978, housing fund 88%, the density of the transportation supply lines on dry land was 22%, power transmission lines 15% from the central to European sectors of the RSFSR. In the Tyumenskaya Oblast, the corresponding indicators in 1979 were:

Item	Total	Including for the complex sectors			
		oil industry	gas industry	geology	construction
Provision with housing fund (in m^2 of total area per person)	10.6	7.8	5.5	7.3	5.8
Provision with children's institutions (in % of need)	70	43	50.8	39	40.8
Provision with schools (in % of need)	84.5	73	51.1	36	-

The formed situation in housing-civil construction requires urgent decisions to be made. They primarily include build-up of cities and workers' settlements with wooden, log, block, prefab, panelboard and other houses that meet the local natural conditions. In this respect a base should be created for wooden panel house building in Tyumen', the kombinats operating in the oblast should be expanded, and the start-up of facilities of prefab and packaged-unit buildings should be accelerated in Ukhta, Saynogorsk, Pyzhm and other cities. The time has come to create plants to produce mobile, container and prefab housing based on modern technology. The region's need for them is 2.5-3 million m^2 per year, based on our calculations.

It is believed that mass use of wooden houses in the build-up of the northern cities and settlements aesthetically deteriorates their architectural appearance. These houses have comparatively little comfort and are not durable. They require

considerable labor expenditures at the construction site. Standard drafts have currently been developed,however, for wooden buildings of improved architectural appearance and sufficient comfort. As for durability, beyond the limits of the general period, the need of the gas and oil complex for personnel and the associated population will diminish. The use of the comparatively nondurable housing fund will reduce the outlays, bearing in mind that in the future it will be necessary to guarantee the residence of only the necessary minimum population in regions with unfavorable and extreme natural and climate conditions.

The social infrastructure, and primarily, the housing-civil construction currently has the greatest influence on the social aspects of development of the complex and determine the nature of the demographic processes. It is planned to triple the annual introduction of housing in the period 1980-1983 as compared to 1979, and in the 4 years to build over 7.2 million m^2 of housing area, schools for 41,500 students, children's preschool institutions for 31,800 places, hospitals for 4,200 beds, and other cultural-general facilities. Involvement of shift-worker brigades from the inhabited regions in construction sites and the enterprises of the construction industry, and build-up of construction-installation organizations in them may be forms of the expedition-watch system in housing construction. The legal aspects of this system have chiefly been defined.

The brigades of the house-building kombinats can operate on the expedition base. Experience in building housing in the zone of BAM [Baykal-Amur Trunkline], KamAZ [Kama Motor Vehicle Plant] shows that the radius of action of the kombinats can reach a thousand kilometers. After completion of construction of the Surgut-Urengoy railroad, this method became effective in building up the base and supporting cities of West Siberia, including the near-polar zones.

The 26th CPSU Congress indicated that the complexity of socioeconomic development of the regions of Siberia and the East is necessary to provide skilled personnel, to regulate migration and for efficient use of labor resources. Large-scale projects have been provided for the rapid resolution of social problems of the oil and gas complex which take into consideration the dynamics and uniqueness of the processes, and local conditions. Maximum reduction in the interruption of theoretical studies and their practical implementation is required.

FOOTNOTES

1. See I. I. Nesterov, et al. "Problemy razvitiya neftedobyvayushchey promyshlennosti Zapadnoy Sibiri" [Problems of Developing the Oil Extracting Industry of West Siberia], Tyumen', 1970.

2. The expedition-watch system also includes methods of organizing production and a method of interregional use of labor resources and social infrastructure. In this article, the expedition-watch method is analyzed as applied to the tasks of socioeconomic development of the new territories.

3. See S. T. Bud'kov,; and V. B. Nefedova, "Sever Tyumenskoy oblasti ["Northern Tyumenskaya Oblast"], Tyumen', 1977.

4. See B. S. Vaynshteyn, and A. D. Khaytun, "In the Interests of Accelerated Development of the Oil and Gas Complex of West Siberia," EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA, No 10, 1979; B. B. Prokhorov "Geographical Conditions of Development of the Ob' North," "Sbornik trudov Instituta geografii Sibiri i Dal'nego Vostoka" [Collection of Works of the Institute of Geography of Siberia and the Far East], Irkutsk, 1975.

5. V. V. Kadnikov, "Osobennosti gradostroitel'stva v neftegazovykh rayonakh Tyumenskoy oblasti" [Features of City Designing and Building in the Oil and Gas Regions of the Tyumenskaya Oblast], Leningrad, 1973; Ye. P. Pertsik, "Rayonnaya planirovka" [Regional Planning], Izdatel'stvo Mysl', 1973.

6. See E. A. Milenina,; K. I. Morozova,; V. P. Smirnov "Problems of City Designing and Building of the Extreme North and Oil and Gas Regions of West Siberia," ARKHITEKTURA SSSR, No 11, 1976.

7. In city designing and building, by taxonomy is meant the distribution and hierarchical systematization of population areas depending on their importance in the system of settlement. The following taxonomy is suggested in the development of West Siberia: supporting regional center (city)--base center--permanent settlement--watch settlement--expedition settlement--field city.

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PRESENT, FUTURE OF PIPELINE TRANSPORT EXAMINED

Moscow NEFTYANAYA PROMYSHLENNOST': SERIYA TRANSPORT I KHRANENIYE NEFTI I NEFTEPRODUKTOV in Russian No 8,1981 pp 2-3

[Article by V. D. Chernyayev, Glavtransneft': "Results of Development of Oil Pipeline Transport in the 10th Five-Year Plan and Tasks for the 11th"]

[Text] The Principal Directions of Development of the USSR National Economy for 1976-1980, ratified by the Decree of the 25th CPSU Congress, specified a substantial increase in oil production and movement of 15,000 kilometers of oil trunk pipelines on-stream during the five-year period. Rapid development of oilfields in Western Siberia, Kazakhstan and other parts of the country, as well as plan targets pertaining to expansion of existing and contruction of new oil refineries dictated the necessity of accelerated growth of the Soviet Union's oil pipeline network and determined their geographic distribution.

The principal goal of development of oil pipeline transport during the years of the Five-Year Plan was to provide capability to handle a concentrated flow of crude oil from the new fields in Western Siberia to the traditional centers of oil refining and transshipment for export. In connection with this, growth of the oil pipeline network was accomplished at a rapid pace. Total mileage of oil pipeline doubled during the 10th Five-Year Plan. Pumped oil volume increased by 20 percent during that same period, while freight turnover increased by 85 percent.

Such high-capacity oil pipelines as the following went into operation during the 10th Five-Year Plan: Nizhnevartovsk-Kurgan-Kuybyshev; Omsk-Pavlodar; Anzhero-Sudzhensk-Krasnoyarsk; as well as the Kuybyshev-Ukraine oil pipeline system, which includes the following pipelines: Kuybyshev-Lisichansk; Lisichansk-Kremenchug, Snigirevka-Odessa. Construction was begun on the Krasnoyarsk-Irkutsk and Surgut-Polotsk. This made it possible to increase the rate of growth of oil pipeline transport freight turnover, which exceeded the oil transfer volume growth rate; the average conveyance distance steadily increased, reaching a figure of 1,874 km by the end of the five-year plan.

Each year volume of oil hauling by other modes of transportation is decreasing. In the last five years, for example, oil hauling by rail declined by 40 percent.

Oil pipeline transport is one of the most capital-intensive segments of the industry. In the last five-year plan volume of capital investment on construction of oil

pipeline transport facilities totaled 3 billion rubles, as a result of which fixed assets in trunk pipelines increased 25-fold, reaching a total of 6.3 billion rubles. Construction of new, large-diameter oil pipelines has become the principal emphasis in technical reequipping of this industry. Approximately 30 percent of all oil pipelines brought on-line in the 10th Five-Year Plan were 1,020 and 1,220 mm in diameter. The Soviet Union is a pioneer in the construction of large-diameter pipelines; the USSR boasts the world's largest average oil pipeline diameter. The trend toward an increase in the diameter of pipelines in the USSR is due to their economical operation and the necessity of concentrating flows of crude oil.

An improvement in the technological level of trunk oil pipelines made it possible to improve the principal indicator characterizing the overall performance of pipeline transport -- cost of transfer.

Methods of rapid, continuous pipeline laying and industrial-type modular unit construction of pumping stations were widely adopted during the 10th Five-Year Plan, which made it possible in a short period of time sharply to improve efficiency of construction output and capital investment in oil pipeline transport, to shorten construction time and to reduce labor outlays.

A total of 79 modular unit oil pipeline pumping stations were brought on-line in the 10th Five-Year Plan.

Automated process control systems have been adopted on more than 35,000 kilometers of main oil pipelines. A total of nine automated production management systems have been adopted at the oil pipeline administration level, which have made it possible to automate basic functions pertaining to control of the financial and management activities of oil transport enterprises. At the branch automated management system level, the first unit of an oil transport subsystem has been incorporated, which handles problems of dispatcher operational control, energy resources record keeping, etc.

The Principal Directions of Economic and Social Development of the USSR for 1981-1985 and the Period Up to 1990 specify crude oil production (including gas condendate) of 620-645 million tons in 1985, with accelerated growth and development of the oil production industry in Western Siberia, in the Kazakh SSR, and in the northern part of the European USSR. Increased demands are imposed on pipeline transport under these conditions. Pipeline transport is targeted for accelerated growth and development, especially for conveying crude oil, refined products and natural gas, with improvement in the quality of construction of pipeline facilities and ensuring their reliable operation.

The main task of transportation in the current five-year plan continues to be full, prompt and timely satisfaction of the national economy's transport needs, as well as improvement in efficiency and quality of transport system operation. The following is essential in order to accomplish this main task:

to improve organization and management of the transport process;

to improve the level of utilization and operational reliability of transport equipment;

to improve coordination of the operation of all modes of transportation and their interaction with other branches and sectors of the economy, and to adopt an improved transport process in combined-mode service;

to strengthen transportation's material and technological base, to accelerate the adoption of new equipment, advanced processes and automated control and management systems, and to improve the level of total mechanization of freight handling, repair and maintenance operations;

to achieve reduction in the adverse effect of transportation on the environment.

In 1981-1985 there will be an increase in oil refining volume by construction of new oil refineries and renovation of existing facilities. New oil refineries will go into operation in Achinsk, Chardzhou and Chimkent, and oil refineries in Khabarovsk, Lisichansk, Mazheykyay and Pavlodar will be expanded.

A further increase in oil production is targeted for Western Siberia in the 11th Five-Year Plan, with northern areas of Tyumenskaya Oblast to commence development. The bulk of the produced Western Siberian crude is to be piped to the European USSR. Conveyance of Western Siberian crude up to 1985 will be handled by building and bringing on-stream the Verkhne-Tarskoye-Kalinovoye-Parabel', Perm'-Al'met'yevsk, Tyumen'-Yurgamysh, Pavlodar-Chimkent, Chimkent-Chardzhou, and Chardara-Fergana pipelines, together with pipeline pumping stations, as well as completion and start-up of pumping stations on the existing Aleksandrovskoye-Anzhero-Sudzhensk, Anzhero-Sudzhensk-Krasnoyarsk-Irkutsk, and Ur'yevskiye-Yuzhnyy Balyk oil pipelines.

Preliminary targets call for bringing on-line in the 11th Five-Year Plan a total of 9,240 kilometers of oil pipeline and 97 pumping stations.

Automated oil transport process control systems will undergo further development. In conformity with the comprehensive program for 1981-1985, in addition to the development of new industrial process automated control systems, principal attention will be focused on the development and improvement of automated control systems developed in the 10th Five-Year Plan. Work is to begin on development of the integrated Transneft' automated control system.

Plan targets include further development and improvement of industrial construction methods in oil pipeline transport, execution of an aggregate of measures to improve main and auxiliary oil pipeline equipment, development of open-air pumping stations, designing of arctic-model pumping stations, and industrialization of construction of service lines and service base facilities.

In addition to the adoption of advanced methods and techniques of equipment servicing and maintenance, the unit-assembly method of repairing pumping station equipment will come into use in 1981-1985. The level of centralized performance of minor repairs and major overhauls (by mobile field service crews) will increase during the 11th Five-Year Plan from 38 percent in 1981 to 65 percent in 1985.

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BOOK SURVEYS ELECTRICAL METHODS OF PROSPECTING IN EXISTING MINES

Yerevan PODZEMNAYA ELEKTRORAZVEDKA NA RUDNYKH MESTOROZHDENIYAKH ARMENII in Russian 1980 pp 3-7, 211-215

[Annotation, table of contents, introduction and conclusion from the book, "Underground Electrical Exploration at Armenia's Ore Deposits," by Stepan Vardkesovich Badalyan, Georgiy Oganezovich Gazaryan and Bagarshak Bagdasarovich Gamoyan of the Order of Labor Red Banner Institute of Geophysical and Engineering Seismology of the Armenian SSR Academy of Sciences, Izdatel'stvo AN [Academy of Sciences] Armyanskoy SSR, 1,000 copies, 222 pages]

[Text] The book examines methods of underground electrical exploration--the natural field (YeP), earth currents (BT), induced polarization (VP) and the superlong-wave variant of the radiokip [radio-comparator and direction-finding] (SDV-radiokip) method--which are being further developed in operations of the Institute of Geophysics and Engineering Seismology (IGIS) of the Armenian SSR Academy of Sciences. The physical bases for these methods are given and the apparatus, the methodology for making measurements and interpretations of the data, and the results of a test of the methods that was made while solving prospecting and exploration tasks at Armenian ore deposits are described briefly.

This monograph is intended for geophysicists and geologists, but it can also be useful to students of geological-exploration faculties who are specializing particularly in the area of ore geophysics.

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Introduction

The directives of the 25th CPSU Congress set for geological exploration organizations the task of increasing the extraction of useful minerals, mainly in the economically developed regions of the Union, which reduces capital-investment expenditures. Because of this, the problem of prospecting and exploring for deep-lying ore targets is posed in all its vastness. This is caused by the circumstance that, in regions that have been well known for a long time, ore raw-material reserves that are located close to the earth's surface not only have been explored already but in some regions have already been completely extracted. Therefore, all future prospects for growth in reserves are increasingly associated with the detection of ore targets that are deposited at great depths. As experience has shown, the solution of this problem can be achieved by integrated geological and geophysical studies.

The existing geophysical methods of study from the earth's surface often do not allow the detection of geological targets that lie at great depths because of the insignificant values of the anomalies they create.

Possible ways for increasing the depth capabilities of geophysical methods of exploration are as follows: increase the sensitivity of the geophysical apparatus and apply simultaneously the newest methods for processing geophysical data, and

introduce geophysical and certain other methods into underground geological exploration practice.

Increasing the depth capability of research by increasing the sensitivity of geophysical apparatus often proves to be impossible because of the great influence of interference that distorts the physical field (the relief--visible and buried, inhomogeneities in the overburden and weathered crust, earth currents and so on). Therefore, one of the branches of geophysical research, which has geen given the name "underground geophysics" [133] and is characterized by geophysical observations made in mine excavations and holes, has been developing successfully in recent years. This will permit perturbing objects that lie at great depths and are inaccessible to observation from the earth's surface to be brought closer, the anomalous effects to be increased, and the influence of surface inhomogeneities to be reduced.

Almost all existing geophysical methods that are used to explore from the earth's surface can be used in underground variants. However, because of the specifics of performing geophysical operations at existing mines of various types, the task of developing new apparatus, methodologies, operating techniques and special methods for interpreting the results of the observations is brought to the fore.

In the past decade the following methods have been developed most in underground geophysics: radiowave, underground recording of cosmic radiation, gravity exploration, thermal exploration, magnetic exploration, seismic exploration, and a few other methods [133].

Underground physics is being further developed in two directions: the improvement of existing methods, and the study of the potential for using methods and modifications not previously used underground [133]. The problem of their integrated use in combination with geological, geochemical and engineering methods for prospecting and exploration is even more important. The latter is the main task in raising the effectiveness of prospecting and exploration at existing enterprises.

Among the various physical fields that can be used in underground mine workings and holes, natural electrical fields are attracting attention. These fields enable the distribution of the ore substance within deposits to be studied. Moreover, they are measured with simple apparatus and great expenditures are not required for studying them. Therefore, the development of an underground variant of the natural-field (YeP) method is of great practical significance.

As the technology for upgrading ore raw materials develops, industry increasingly uses ores with a low useful-component content. Ore bodies in this case are often represented by veinlet, veinlet-impregnation and impregnation mineralization. As geophysical research experience has indicated, the induced polarization (VP) method, different modifications of which enable ore bodies to be discovered and the elements of deposition within them to be identified, plays no small role with such ores. Therefore, use of the VP method underground can be of practical significance in solving tasks of the geological exploration and development of ore deposits.

The radio-comparator and direction-finding method that uses mainly the field of superlong-wave radios that operate in the 10-30 kilohertz frequency band occupies an important place in high-frequency electrical exploration [130]. The SDV-radiokip

[superlong-wave radio-comparator and direction-finding] method permits geological surveys and prospecting to be performed at small expense in money and time. Because superlong radiowaves penetrate rocks to great depths, the method can also be applied successfully to underground conditions, expanding its potential considerably. The development and use of this method underground involves simplicity of surveying and uncomplicated apparatus and methods of interpretation.

As is known, intense mine-operation electrical interference or earth currents (BT), which often hamper the use of various electrical-exploration methods, are observed at operating ore mines. As the miners' use of technical equipment expands, the presence of earth currents within the ore fields being worked becomes an ordinary phenomenon. Because of this, the thought arises naturally about using mine-operation electrical fields in underground mine workings to prospect and explore for useful minerals.

Along with other Union organizations, the Institute of Geophysics and Engineering Seismology (IGIS) of the Armenian SSR Academy of Sciences is taking an active part in developing underground electrical exploration methods. It should also be noted that underground geophysical research in Armenia, aside from IGIS's, is being fruitfully employed by geophysicists of the Geological Administration and Geological-Exploration Operations Trust of the Administration for Nonferrous Metallurgy of the Armenian SSR Council of Ministers.

This work is thus dedicated to the development and testing of YeP, VP, BT and SVD-radiokip methods as they apply to underground conditions.

This monograph consists of an introduction, five chapters, and a conclusion. The introduction, conclusion and chapter 5 were written by S. V. Badalyan, G. O. Gazaryan and V. B. Gamoyan, chapters 1 and 3 by V. B. Gamoyan, chapter 2 by S. V. Badalyan and chapter 4 by G. O. Gazaryan.

While writing the book, the authors benefited from valuable advice by Candidate of Geological and Mineralogical Sciences and Yerevan State University Lecturer G. M. Vantsyan.

The authors will consider all readers' remarks and recommendations with gratitude and ask that they be sent to: 377500, Leninakan, Leningradskaya Ulitsa, 5, IGIS.

Conclusion

The results of studies of the development of the YeP, VP, BT and SDV-radiokip methods of underground electrical exploration and of their testing at various types of deposits permit the conclusion that the use of these methods will increase considerably the economic effectiveness of geological exploration.

It was established that in underground conditions, filtration fields and fields associated with metallic underground mining equipment possess, as a rule, small intensity and can be considered as simple processes. Distortions of the fields introduced by mine workings are amenable to recording on the basis of the appropriate calculations. Thus gives rise to realistic conditions for wide use of natural-field observations for the practical purpose of detecting new bodies of ore in the vicinity of workings and for tracing known bodies between workings.

In an environment that is uniform in polarizability, neither a mine working nor the surface relief has any influence on the results of underground observations by the VP method. However, in an inhomogeneous environment, the influence of the mine working and the relief of the earth's surface is observed. Rails that have been laid along a mine working raise the polarizability level by 3-8 percent.

When trolley-wire electric locomotives move in mine workings that are 100-1,000 meters from the object being studied, the possibility of using the VP and YeP methods is completely precluded. Observations by these methods are possible only if the mine's electric current is turned off. In the opposite case, use of the earth currents method, which enables geophysical research to be conducted without disturbing the working rhythm of the industrial enterprise (the mine), is desirable. The method developed for studying earth currents enables the influence of the mine workings, metallic mining equipment and other interference to be precluded or reduced.

It was established that superlong-wave radio signals are received reliably in underground mine workings at depths of 300-350 meters, where the field intensity at certain deposits is 20-25 percent of that recorded at the earth's surface. The influence of the various types of interference caused by metallic mine structure on an SDV field is insignificant and is excluded by comparatively simple methods.

The YeP Method. The nature of the distribution and intensity of natural fields is determined by the type of mineralization, the size of the ore targets, their locations relative to each other in space, and the texture of the ores. The actual linear dimensions of the field are 1.4-fold to 1.7-fold greater than the linear dimensions of the ore bodies. New bodies can be detected and known bodies traced by means of the natural field at distances up to 100 or more meters from the mine working being surveyed. The ratio established between the linear dimenions of the negative and the positives areas of the field, which is 1/3 to 1/5, will enable a forecast to be made, in accordance with the result of a study of the field over a certain portion, of the dispersion of the ore by depth, and, thereby, an assessment to be made of the deposit's prospects. The nature of the field's 3-dimensional structure is associated with the type of mineralization, and it can be used to obtain the appropriate geological information.

A study of the natural fields at deposits has shown the dependence of the spatial distribution of the chemical elements in waters upon the 3-dimensional structure of the field.

The VP Method. A comparison of the computed and the experimental curves of VP fields for oblong bodies of arbitrary cross-section indicates satisfactory coincidence. In interpreting the results of underground observations, the circumstance is considered that the distribution of the electrical field occurs in absolute space, and the geological object can be situated higher or lower than or on the same horizon as the profile of the observation. The VP method for prospecting and exploring for ore bodies has been defined, and its potential for solving geological-structure tasks has been proved.

The BT Method. By means of a methodology of observations that has been developed which permits the ratio of gains of potentials to be determined, the electrical fields of mine-operation earth currents can be studied for prospecting and exploration purposes. Practical observations have indicated a potential for tracing ore

bodies between mine workings and also for observing them in the vicinity of the workings being surveyed.

The Superlong-Wave Radio-Comparator and Direction-Finding Method. Based upon the general theory of the propagation of superlong radiowaves, approximate expressions for normal and anomalous fields have been obtained for underground conditions, taking into account peculiarities of the relief, the trend of the profile, and the location of the exciting object.

This has enabled the following prerequisites for determining the position of the object being sought to be established:

1) during observations in underground mine workings, the minimal value of the intensity of the magnetic field's horizontal component corresponds to a conducting object that occurs above the working, while the maximum value corresponds to one that is below it; a chart of the intensity of the vertical component H_z has in both cases one and the same configuration and the position of the exciting object cannot be determined from it;

2) when measuring the field in a vertical hole, the maximum value H_z is observed where the horizontal plane is the earth-air interface in the area of the ore object, while the H_p curve has a maximum above the edge of the ore object and a minimum value below it; the spatial position of the ore object cannot be established by these curves; and

3) when measuring the field in slanted and vertical holes, the spatial position of the ore object relative to the hole's axis can be established in accordance with the H_z and H_p curves where the plane of the earth-air interface is an inclined plane.

When organizing underground geophysical operations, special requirements are laid on the apparatus used (imperviousness to water and dust, and portability). In this connection a hole apparatus has been developed for the SDV-radiokip method with probes that permit the axis and the normal to the axis of the magnetic-field component to be measured in the hole. An instrument for measuring the ratio of the gains of earth-current potentials has been developed. The possibility of using the VP-59 electrical exploration set, Ertsprospektor instruments, the ESK-1 and other equipment for underground work by the VP and YeP methods has been demonstrated.

In conclusion, it can be noted that use of the methods of underground electrical exploration that were tested in prospecting for new and in exploring known ore bodies is a realistic method for expanding the prospects of existing mining enterprises. A basic task for further development of underground variants of YeP, VP, BT and SDV-radiokip methods should be both their introduction into production and improvement of the theoretical, methodological and equipment bases of the methods.

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